

The coherent conversion of microwave to optical signals is for now a missing hardware for long-distance quantum communication between superconducting quantum (sub)processors that could form the nodes of a future quantum network. Various architectures for quantum simulations and information processing are being currently explored with different TRL levels. Among these, circuits of superconducting qubits have already moved from the fundamental research environment to the R&D units of companies. Recent developments have shown extraordinary abilities for performing fast and high-fidelity quantum logic operations. Their limitations are short coherence times precluding long-term storage of quantum information, and the difficulty of coupling distant quantum registers using microwave photons that are (near)resonant with qubit transitions. There is therefore a need to develop efficient system to inter-connect the Microwave domain, realm of quantum computing and the optical domain, realm of quantum communications. In this presentation, I will describe two connectable devices that optimize MW to optical coupling to a single cold atom system : The first is a new type of coupled micro-wave resonator allowing to create a 3D subwavelength magnetically coupled MW volume, the second is an elongated atomic guide fitting in the MW volume that strongly enhance the optical emission. This work is realized in collaboration with the MOCA consortium that received the support from the QuantERA ERA-NET Cofund and develops an integrated atom chip to interconnect superconducting MW processing and optical communication networks.